



UNIVERSITY OF MAINE AT FARMINGTON
COLLEGE OF EDUCATION, HEALTH AND REHABILITATION

LESSON PLAN FORMAT

Teacher's Name: Kiera Timme **Lesson #:** 4 **Facet:** Apply

Grade Level: Grade 8 **Numbers of Days:** 3

Topic: Operations involving Scientific Notation

PART I:

Objectives

Students will understand that scientific notation is used/ can be used to represent large and small quantities.

Students will know scientific notation operations and problem solving strategies.

Students will be able to solve problems involving scientific notation.

Product: Show Me App

Common Core State Standards (CCSS) Alignment

Common Core State Standards

Content Area: Mathematics

Grade Level: Grade 8

Domain: *Expressions and Equations*

Cluster: *Work with radicals and integer exponents.*

Standard: *Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is smaller than the other. For example, estimate the population of the United States as 3×10^8 and the population of the world as 7×10^9 , and determine that the world population is more than 20 times larger.*

Rationale:

In this class, students will extend their knowledge of scientific notation through an exploration of the processes involved in performing operations with numbers expressed in scientific notation.

Assessments

Formative (Assessment for Learning)

Section I – checking for understanding during instruction

After the class discussion and activities, the class will take an informal quiz, and use the "thumbs up, side, down" activity, in order to check for understanding. I will also review the inverted triangle graphic organizers generated by the students in order to assess student understandings.

Section II – timely feedback for products (self, peer, teacher)

Problems from the student generated quizzes will be taken, informally, by the class using clickers during the third session. Students will be shown a student sample, and provided with checklist, to self-assess their "show me" answer key. I will then meet one-on-one with each student to view their answer key and,

using the checklist, provide specific feedback so students can make adjustments.

Summative (Assessment of Learning):

Students will design an 8 question scientific notation operations quiz for their fellow classmates. Then, using the "Show Me" app, students must create a step by step answer key for each question. As the app allows you record while you write, the answer key must include a verbal component. This could be an explanation of each step as you go, or you do your explanation through a song or a rap.

Integration

Technology:

Students will use the Show Me app on the iPad to create their quiz answer keys. Students will also be using iClickers.

Content Areas:

English - Students will be writing in reflective journals (on-going)

Groupings

Section I - Graphic Organizer & Cooperative Learning used during instruction

The Partners activity will be used to pair students up. Each partner will be assigned the inverse operation to a scientific notation problem they must solve. They must use the inverted triangle chart to display each step they used when solving. One chart will be made per problem type. Then the partners will meet up and try to attempt a new, but similar problem, using their partners inverted triangle chart as a guide.

Section II – Groups and Roles for Product

Students must work with a partner to complete the inverted triangle organizer. Students must explain their solutions, of the inverse operation, to their partner. Students will work individually while creating their products; however, students will be encouraged to work with their peers to ensure that their answer keys are effective.

Differentiated Instruction

Verbal: Students will create an answer key using the "show me" app which allows them to verbally communicate each step in the process.

Logic: Students will be connecting their knowledge of exponents and applying them during the inverted triangle activity and when creating their answer key.

Visual: Students will be using an inverted triangle organizational chart to clearly define each step when performing operations using scientific notation. The "show me" app acts like an interactive white board allowing students to use a variety of colors, shapes, etc... to create their answer key.

Kinesthetic: When students use the "show me" app, they will use their fingers as the writing/drawing tool.

Musical: Students could choose to have a musical accompaniment to their "show me" answer key. The oral aspect of their answer key could be done through song or rap.

Interpersonal: Students will share their solutions steps with their partner, and discuss how and why they solved the problems the way that they did.

Intrapersonal: Students will work independently on their problems before sharing. They will also be required to create their quizzes and answers keys on their own

Modifications/Accommodations

From IEP's (Individual Education Plan), 504's, ELLIDEP (English Language Learning Instructional Delivery Education Plan) I will review student's IEP, 504 or ELLIDEP and make appropriate modifications and accommodations.

Plan for accommodating absent students:

The class will have its own Wiki website. All handouts and assignments, will be posted on the class wiki. At the end of the class period any SmartBoard presentations will also be uploaded onto the wiki. All students will also be provided with video links that relate to the content being taught to supplement instruction. Anytime a new technology is introduced a student/teacher created screencast or manufacturer tutorial will be posted into the class wiki as a guide on how to use this technology.

Extensions

Type II technology:

Students will use the Show Me app on the iPad to create their quiz answer keys. Students will also be using iClickers.

Gifted Students:

When student create their products, they will be given a menu of problem choices. Students may choose 8 problems from the menu for their quizzes, every student/group will choose 6 entrees and a choice of two problems from the starters and desserts. These problems will be tiered. Entrees will be designed to meet the standard, Starters will be for designed for students who are working towards the standard, and Dessert will be designed to exceed the standard as a form of extension. ALL students will have the option to create their own problems; however, these must be pre-approved by the teacher.

Materials, Resources and Technology

List all the items you need for the lesson.

- My laptop
- Student Laptop
- My iPad
- Student iPads (sign up for this)
- SmartBoard (sign up for this)
- iClickers (sign-up for this)
- iClicker software (ensure i have software)
- Show me app screencast/tutorial
- Show Me App - Answer Key (Student Sample)
- Whiteboard
- Whiteboard Markers
- Updated class wiki
- Checklist
- Textbook
- Problems Menu
- Inverted Triangle Organizer

Source for Lesson Plan and Research

VIDEO - How to perform operations with scientific notation:

<http://www.youtube.com/watch?v=Ao9JwZpZ3KI>

Cliffnotes - Scientific Notation Operations:

http://www.cliffsnotes.com/study_guide/Scientific-Notation.topicArticleId-254915,articleId-254835.htm

VIDEO: How to use Show Me:

<http://www.showme.com/sh/?h=shDHxk8>

Online Quickie Quiz:

<http://www.buzzmath.com/Docs/#CC08E363>

Class wiki:

www.wikispaces.com

PART II:

Teaching and Learning Sequence (Describe the teaching and learning process using all of the information from part I of the lesson plan) *Take all the components and synthesize into a script of what you are doing as the teacher and what the learners are doing throughout the lesson. Need to use all the WHERETO's. (3-5 pages)*

Agenda:

Day One (80 minutes):

- Attendance (3 minutes)
- Hook (5 minutes)
- Smartboard lecture & Group Discussion about scientific notation operations: Add/Subtraction (12 minutes)
- Partners & Inverted Triangle organizer activity (10 minutes)
- SmartBoard lecture & Group Discussion about scientific notation operations: Multiplication/Division (15 minutes)
- Partners & Inverted Triangle Graphic Organizer activity (10 minutes)
- SmartBoard lecture & Group Discussion about scientific notation operations: Raising to Exponents (10 minutes)
- Partners & Inverted Triangle Graphic Organizer activity (10 minutes)
- Journaling (5 minutes)

Assignment: Complete graphic organizers from previous lesson (if incomplete). Explore "Show Me" app on iPads (watch *how to* guide). Make a quick tutorial on how to make a peanut butter and jelly sandwich.

Day Two (80 minutes):

- Attendance & H/W and/or Student directed Q&A (5-10 minutes)
- Team Quickie Quiz: "Scientific Notation Operations" (10 minutes)
- Create Quizzes (begin making answer key on organizer) (45 minutes)
- Class discussion on any areas that are still unclear (10 minutes)
- Journaling (5 minutes)

NOTE: *Collect copies of student quizzes to generate iClicker problems for next class*

Assignment: Create "Show Me" answer key to your quiz.

Day Three (80 minutes):

- Attendance & H/W and/or Student directed Q&A (5-10 minutes)
- iClicker Quiz - one problem from each student quiz (40 minutes)
- Show Me App Answer Key Gallery Walk (Peer review) (25 minutes)
- Journal (5 minutes)

Classroom Arrangement: Students will be arranged into table groups of four.

Students will understand that scientific notation is used/can be used to represent large and small quantities. Not only does scientific notation allow us to express numbers more efficiently, it also allows us to perform operations with these very large and very small numbers more effectively. *Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is smaller than the other. For example, estimate the population of the United States as 3×10^8 and the population of the world as 7×10^9 , and determine that the world population is more than 20 times larger.* The hook is designed to appeal to the students' desire for shortcuts. At the start of the lesson I will say: "Do you like shortcuts?.. Yes! Well good news! Our exponent properties are just the tools we need to perform scientific notation operations!" At this point I will refer students to a link on the class wiki with their "Exponent News Broadcast" movies as a way to remind themselves about the properties of exponents.

Where, Why, What, Hook Tailors: Verbal, Logic, Visual, Musical, Naturalist, Interpersonal, Intrapersonal

Students will know scientific notation operations and strategies for solving them (*see content notes*). We will begin by having a lecture and class discussion about how to add and subtract numbers expressed in scientific notation. In order to maintain student interest, lectures/discussions will be spaced out. As such, after each component lecture/discussion, students will partner up to complete the inverted triangle graphic organizer activity. Each partner will be assigned the inverse operation to a scientific notation problem they must solve. They must use the inverted triangle chart to display each step they used when solving. One chart will be made per problem type. Then the partners will meet up and try to attempt a new, but similar problem, using their partners inverted triangle chart as a guide. Each round, students must work with a new partner. Students will then reflect on the lesson, and summarize their understanding, by writing in their journals. During instruction (first session) the "thumbs up, side, down" activity will be used to check for understanding. After the H/W review, students will be split into teams of three to participate in the informal "Quickie Quiz." This quiz is an opportunity for students to review the material and assess their understanding. It also provides students with an opportunity to generate ideas for their

quizzes.

Equip, Explore, Rethink, Tailors: Verbal, Logic, Visual, Interpersonal, Intrapersonal

Students will be able to solve problems involving scientific notation. After the informal quiz, students will begin work on their individual "Show Me" app products. When student create their products, they will be given a menu of problem choices. When creating their products students may choose 8 problems from the menu for their quizzes, every student/group will choose 6 entrees and a choice of two problems from the starters and desserts. These problems will be tiered. Entrees will be designed to meet the standard, Starters will be for designed for students who are working towards the standard, and Dessert will be designed to exceed the standard as a form of extension. ALL students will have the option to create their own problems; however, these must be pre-approved by the teacher. Students will use the "Show Me" app create a step by step answer key for each question on their quizzes. As the app has audio recording capabilities, the answer keys must include a verbal component. This could be an explanation of each step as you go, or an explanation through a song or a rap. Students are to make use of the graphic organizers to begin the prep work for their answer key. Each problem they create should be worked out on the inverted triangle organizer. Students will share and compare these with their classmates, and I will also provide students with feedback. Students will be shown a student sample, and provided with checklist, to self-assess their "show me" answer key

Explore, Experience, Rethink, Revise, Refine, Tailors: Interpersonal, Intrapersonal, Verbal, Logical, Visual, Kinesthetic

Students will use their journal entries, graphic organizers and a checklist to help create and self-assess their show me products. Problems from the student generated quizzes will be taken, informally, by the class using clickers during the third session. I will then meet one-on-one with each student to view their answer key and, using the checklist, provide specific feedback so students can make adjustment. I will review their show me products electronically and then use the same checklist to provide feedback so they can make adjustments before the final grading is completed. In order to indicate that they are ready for the products to be assessed, students will post a link to their blog onto the class wiki. The homework assignments are designed to provide students with an opportunity to better acquaint themselves with the technology we will be using in a risk free way. This lesson provides students with a foundation from which they can build, familiarizing them with the process of performing operations so we develop on these ideas, through an exploration of the material in terms of the real world, in the next lesson.

Evaluate, Tailors: Verbal, Visual, Interpersonal, Intrapersonal, Logical

Content Notes

Students will know.....

Definitions:

- *Scientific Notation Operations*

Addition & Subtraction

When adding or subtracting in scientific notation, you must express the numbers as the same power of 10. This will often involve changing the decimal place of the coefficient.

Example: Add 3.76×10^4 and 5.5×10^2

First, you must move the decimal to create like terms

So 5.5×10^2 becomes 0.055×10^4

Here we moved the decimal **two** spaces to the left (which is like dividing by 100), which meant we added two to the exponent

Then, add the coefficients and leave the base and exponent the same:

$$3.76 + 0.055 = 3.815 \times 10^4$$

REMINDER:

This is like our **exponent rules**, we can only combine (add/subtract) *like terms*.

By moving the decimal place, we can manipulate our numbers expressed in scientific notation. This allows us to create like terms which we can then combine.

The same idea applies to subtraction. However, you must ensure you subtract the coefficients in the correct/given order.

Example: Perform the indicated operation: $(7.83 \times 10^{-2}) - (2.20 \times 10^{-3})$

First, we move the decimal to create like terms

So 7.83×10^{-2} becomes 78.3×10^{-3}

Here we moved the decimal **one** space to the right (which is like multiplying by 10), which meant we subtracted one from the exponent

Now we can subtract the coefficients and leave the base the same

$$78.3 - 2.30 = 76.1 \text{ giving us } 76.1 \times 10^{-3}$$

Although this answer is numerically correct, it is not in proper scientific notation. The number in front of the decimals (in the units position), must be between 1 and 9.

So...

$$76.1 \times 10^{-3} \text{ becomes } 7.61 \times 10^{-2}$$

Multiplication & Division

When *multiplying* two numbers in scientific notation, you multiply the coefficients together, then powers of ten are added (add the exponents).

Example: Perform the indicated operation: $(4.42 \times 10^{-3}) \times (4 \times 10^{-2})$

REMINDER:

This is like our **exponent rules**.
When we multiply numbers
exponents of the same base,
we add the exponents.

$$\begin{aligned}(4.42 \times 10^{-3}) \times (4 \times 10^{-2}) \\&= (4.42 \times 4)(10^{-3} \times 10^{-2}) \\&= (17.68 \times 10^{(-3 + -2)}) \\&= 17.68 \times 10^{-5}\end{aligned}$$

Once again, we must check that our solution is in proper scientific notation form

$$\begin{aligned}&= 17.68 \times 10^{-5} \\&= 1.768 \times 10^{-4}\end{aligned}$$

When *dividing* numbers in scientific notation, we divide the coefficients (in the given order), and then the powers of ten are subtracted (subtract the exponents).

Example: Perform the indicated operation: $(3.5 \times 10^{-2}) \div (5 \times 10^6)$

So.... $(3.5 \times 10^{-2}) \div (5 \times 10^6)$

$$\begin{aligned}&= \frac{3.5 \times 10^{-2}}{5 \times 10^6} \\&= \frac{3.5}{5} \times \frac{10^{-2}}{10^6} \\&= 0.7 \times 10^{(-2 - 6)} \\&= 0.7 \times 10^{-8}\end{aligned}$$

Power Raised to a Power

Multiplication/Division:

Sometimes we will encounter problems where we are asked to multiply or divide numbers expressed in scientific notation that have also been raised to a power.

Example: $[(2.3 \times 10^{-2})(1.5 \times 10^3)]^2$

In this case, we must first distribute the outside exponent to the inside expression (give every piece the exponent)

$$[(2.3 \times 10^{-2})(1.5 \times 10^3)]^2$$

$$= (2.3^2 \times 10^{-4})(1.5^2 \times 10^6)$$

$$= (5.29 \times 10^4)(2.25 \times 10^6)$$

$$= 11.9025 \times 10^{10}$$

$$= 1.19025 \times 10^9$$

Now we follow the steps for multiplication ☺

REMINDER:

This is like our **exponent rules**. When we encounter a power raised to another power, we multiply the exponents.

Addition/Subtraction:

In some cases we are asked to add or subtract numbers which have been raised to a power.

Example: $[(3.2 \times 10^{-1}) + (1.09 \times 10^3)]^2$

Here we must be careful. Since our values are separated by addition (or if subtraction), we cannot simply distribute the exponent to each term.

In this case, it is easier to first simplify the inside then we can distribute the exponent of 2.

$$[(3.2 \times 10^{-1}) + (1.09 \times 10^{-3})]^2$$

$$= [(0.032 \times 10^{-3}) + (1.09 \times 10^{-3})]^2$$

$$= [(0.032 + 1.09) \times 10^{-3}]^2$$

$$= (1.122 \times 10^{-3})^2$$

$$= 1.122^2 \times 10^{-6}$$

$$= 1.258884 \times 10^{-6}$$



TEACHER NOTE: Use instructor textbook if additional examples

Handouts

Inverted Triangle

Problems Menus

Checklist

Maine Common Core Teaching Standards for Initial Teacher Certification and Rationale

Standard 1 – Learner Development. The teacher understands how learners grow and develop, recognizing that patterns of learning and development vary individually within and across the cognitive, linguistic, social, emotional, and physical areas, and designs and implements developmentally appropriate and challenging learning experiences.

Learning Styles

Clipboard: This lesson is structured to incorporate sequential learning with clear procedures on how to master the content. Lesson expectations are clearly outlined both during the lesson and on the class wiki.

Microscope: This lesson allows for student self-discovery of the content. Students are encouraged to discuss the content with their peers, and to develop a sense of ownership of what they are learning, particularly when designing their own quizzes. This is facilitated when students are formulating their own solutions, and then sharing their solutions with their peers. Students are also free to create their own problems for their quizzes provided their choices meet with teacher approval.

Puppy: Students are partnered up in a way to encourage a supportive atmosphere. At all times every effort will be made to ensure a positive and encouraging learning environment. In particular, during group discussion and presentation, students will be encouraged (and required) to actively listen to their peers comments. Since the show me app is a new technology, students are given an opportunity to play with this new technology, as part of a homework assignment, in a risk free way.

Beach Ball: The problems menu provides students with a choice in the problems they solve. Students are also free to create their own problems for their quizzes provided their choices meet with teacher approval. Students will also partake in a content themed quickie quiz, providing students with an additional and varied learning opportunity. The class wiki will also contain links to other resources for students to study this material.

Rationale: This lesson is designed to review and reinforce the material discussed in previous lessons, while also introducing new material in an engaging and meaningful way for all learning styles.

Standard 6 - Assessment. The teacher understands and uses multiple methods of assessment to engage learners in their on growth, to monitor learner progress, and to guide the teacher's and learner's decision making.

Formative: After the class discussion and activities, the class will take an informal quiz, using iClickers, in order to check for understanding. I will also review the inverted triangle graphic organizers generated by the students in order to assess student understandings. Problems from the student generated quizzes will be taken, informally, by the class using clickers during the second session. Students will be shown a student sample, and provided with checklist, to self-assess their "show me" answer key. I will then meet one-on-one with each student to view their answer key and, using the checklist, provide specific feedback so students can make adjustments.

Summative: Students will design an 8 question scientific notation operations quiz for their fellow classmates. Then, using the "Show Me" app, students must create a step by step answer key for each question. As the app allows you record while you write, the answer key must include a verbal component.

This could be an explanation of each step as you go, or you do your explanation through a song or a rap.

Rationale: A variety of assessment forms are used throughout this lesson which provide both the teacher to check for student understanding, and to allow students to assess their own understanding through self-reflection and peer reviews.

Standard 7 - Planning Instruction. *The teacher plans instruction that supports every student in meeting rigorous learning goals by drawing upon knowledge of content areas, curriculum, cross-disciplinary skills, and pedagogy, as well as knowledge of learners and the community context.*

Content Knowledge: Students will know the necessary processes to perform scientific notation operations

Common Core State Standards

Content Area: Mathematics

Grade Level: Grade 8

Domain: *Expressions and Equations*

Cluster: *Work with radicals and integer exponents.*

Standard: *Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is smaller than the other. For example, estimate the population of the United States as 3×10^8 and the population of the world as 7×10^9 , and determine that the world population is more than 20 times larger.*

Facet: Apply

Rationale: Students will be able to solve problems involving scientific notation

Standard 8 - Instructional Strategies. *The teacher understands and uses a variety of instructional strategies to encourage learners to develop deep understanding of content areas and their connections, and to build skills to apply knowledge in meaningful ways.*

MI Strategies:

Verbal: Students will create an answer key using the "show me" app which allows them to verbally communicate each step in the process.

Logic: Students will be connecting their knowledge of exponents and applying them during the inverted triangle activity and when creating their answer key.

Visual: Students will be using an inverted triangle organizational chart to clearly define each step when performing operations using scientific notation. The "show me" app acts like an interactive white board allowing students to use a variety of colors, shapes, etc... to create their answer key.

Kinesthetic: When students use the "show me" app, they will use their fingers as the writing/drawing tool.

Musical: Students could choose to have a musical accompaniment to their "show me" answer key. The oral aspect of their answer key could be done through song or rap.

Interpersonal: Students will share their solutions steps with their partner, and discuss how and why they solved the problems the way that they did.

Intrapersonal: Students will work independently on their problems before sharing. They will also be required to create their quizzes and answers keys on their own

Type II Technology: Students will working individually, using the Show Me app on the iPad, to create their quiz answer key products. Students will also be taking a student generated informal quiz using

iClickers.

Rationale: This lesson is designed to meet the needs of seven of the eight multiple intelligences in a meaningful and engaging way. Journaling, with its reflective components, meet the needs of both verbal and intrapersonal intelligences. The hands-on components provide an opportunity for kinesthetic and visual learners to engage with the content. Group work provides interpersonal learners with the opportunity to engage with their peers. The show me app (product) provides an avenue for musical students to incorporate their interests. The logical structure and sequence incorporated throughout the exploration of the content appeals to logical students.

NETS STANDARDS FOR TEACHERS

1. Facilitates and Inspire Student Learning and Creativity. Teachers use their knowledge of subject matter, teaching and learning, and technology to facilitate experiences that advance student learning, creativity, and innovation in both face-to-face and virtual environments.

a. Promote, support, and model creative and innovative thinking and inventiveness

b. Engage students in exploring real-world issues and solving authentic problems using digital tools and resources

c. Promote student reflection using collaborative tools to reveal and clarify students' conceptual understanding and thinking, planning, and creative processes

d. Model collaborative knowledge construction by engaging in learning with students, colleagues, and others in face-to-face and virtual environments

Rationale: While students create their show me products, they are creating a fun and engaging solutions key that demonstrates their learning. These technology based products are then uploaded to the class wiki and are shared with the school community.

2. Design and Develop Digital Age Learning Experiences and Assessments. Teachers design, develop, and evaluate authentic learning experiences and assessment incorporating contemporary tools and resources to maximize content learning in context and to develop knowledge, skills, and attitudes identified in the NETS-S.

a. Design or adapt relevant learning experiences that incorporate digital tools and resources to promote student learning and creativity

b. Develop technology-enriched learning environments that enable all students to pursue their individual curiosities and become active participants in setting their own educational goals, managing their own learning, and assessing their own progress

c. Customize and personalize learning activities to address students' diverse learning styles, working strategies, and abilities using digital tools and resources

d. Provide students with multiple and varied formative and summative assessments aligned with content and technology standards and use resulting data to inform learning and teaching

Rationale: In this lesson, students are exposed to a creative use of technology (the quickie quiz), which provides students with an opportunity to review, reflect and to be inspired from. Use of the show me app, via the iPad, provides students with the opportunity to explore and utilize a type II technology as a means to demonstrate their learning in a valid and creative way.